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part of the high energy is reflected by the thin film to form reflected energy that irradiates a second position of the thin film through a course change of the reflected energy.

REMARKS

Claims 1, 2 and 4-63 are pending herein. By this Amendment, claims 1, 12, 19, 20, 24, 25, 29, 30, 34, 35, 39, 40, 44-46, 50 and 56 are amended to recite that the window through which the energy is applied exhibits transparency to the energy, and that a distance between the window and an object material is more than about 20 mm. Support for the amendment is found in the specification, for example, at page 27, lines 15-20.

No new matter is added.

The attached Appendix includes a marked-up copy of each rewritten claim (37 C.F.R. §1.121(c)(1)(ii)).

Applicants appreciate the courtesies shown to Applicants' representative by Examiner Rao in the June 4 interview. Applicants' separate record of the substance of the interview is incorporated into the following remarks.

I. Rejection Under 35 U.S.C. §103(a)

A. Claims 1, 2, 4-18, 20-23, 25-28, 30-33 and 35-38

Claims 1, 2, 4-18, 20-23, 25-28, 30-33 and 35-38 were rejected by the Patent Office under 35 U.S.C. §103(a) over U.S. Patent No. 5,329,207 to Cathey et al. (hereinafter "Cathey") in view of U.S. Patent No. 5,200,630 to Nakamura et al. (hereinafter "Nakamura"). Applicants respectfully traverse the rejection.

Cathey fails to teach or suggest the present invention. Instead, Cathey teaches methods for forming baseplates for flat panel displays comprising a "relatively thick semiconductor substrate." The semiconductor substrate of Cathey is a macro-grain polycrystalline substrate which is amorphized by ion implanation or reformed by

recrystallization to obscure the grain boundaries. The "relatively thick" semiconductor substrate is "greater than 300 microns." (See column 1, lines 58-60).

However, Cathey fails to teach or suggest that energy is applied through a window that exhibits transparency to the energy, wherein the window is at a distance of more than about 20 mm from an object material as recited in independent claims 1, 12, 25, 30 and 35 of the present application.

See page 3
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8019A
Nakamura
page 7

Nowhere does Cathey provide any teaching(s) regarding a distance between such a window and an object material. As set forth on page 27 of the present specification, for example, "In order to decrease the size of the high energy supply apparatus itself and facilitate replacement of the atmosphere in the supply chamber, the unnecessary space in the supply chamber must be eliminated as much as possible. In consideration of setting and removal of the object material and vibration in operation of the setting base, the shortest distance between the wall and the object material is about 2 mm to 40 mm. On the other hand, the scattering range of the object material changes with pressure in the supply chamber. For example, the scattering range under a vacuum of about 10^{-5} Torr reaches about 10 cm or more, while the scattering range under atmospheric pressure is about 10 mm or less. Therefore, if melt crystallization is progressed under pressure of atmospheric pressure or higher, as described above in the previous chapter, <u>the sufficient distance between the introduction window and the object material is about about 20 mm or more</u>." (Emphasis added).

Cathey fails to teach or suggest such an introduction window or a distance between the introduction window and the object material, or any reason to provide such a distance. Thus, one of ordinary skill in the art would not have been led to the present invention by the teachings of Cathey.

Nakamura fails to remedy the deficiencies of Cathey. In particular, Nakamura also fails to teach or suggest that energy is applied through a window that exhibits transparency to the energy, wherein the window is at a distance of more than about 20 mm from an object material as recited in claims 1, 12, 25, 30 and 35 of the present application.

Further, Nakamura only teaches the use of hydrogen plasma atmospheres. Nowhere does Nakamura teach or suggest using a gas containing a "component element of the semiconductor thin film <u>and</u> hydrogen" as claimed in claim 12. (Emphasis added). Claims 13-18 depend from claim 12 and accordingly are also allowable.

The method of claim 12 includes positioning the introduction window relative to the thin film, and particularly "at a location resistant to adherence of components of the thin film when the high energy is supplied to the thin film." This language is not merely "functional language" as asserted in the Office Action. Rather, this language is a positive step of the claimed <u>method</u>. Further, even if the recited language is functional language (and Applicants do not admit that it is), the claimed feature must still be taught or suggested by the applied references. However, neither one of Cathey or Nakamura teaches or suggests this feature of the recited method.

The Patent Office does not provide any reason why this claimed feature would be inherent in Cathey or Nakumura. Neither of these references discloses <u>any</u> positioning of an introduction window relative to a thin film. As set forth above, Cathey does not even in the first place disclose any such introduction window. Nakamura is completely silent regarding any specific spacing of the window 52 and the amorphous silicon 53 shown in Fig. 6, or even that this spacing is of any concern or important for any reason.

The Patent Office states no reason why this claimed result would inherently occur in Nakamura in the absence of any teaching or suggestion regarding this result. Applicants

further note that the Patent Office remained silent regarding this argument in the Final Office Action. for all reasons stated

In contrast, the present specification explains that the introduction window needs to be sufficiently separated from the object material to be crystallized, as compared to the scattering range of the object material, so that the components of the object material hardly adhere to the introduction window. Nakamura does not disclose this feature, either expressly or inherently. According to the Manual of Patent Examining Procedure (MPEP) §2112, the "Examiner must provide rationale or evidence tending to show inherency. The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic." *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993). In order to establish that a certain result is inherent, it <u>must</u> be established that the inherency is a <u>necessary result</u> and not merely one <u>possible result</u>; the mere fact that a certain thing may result from a given set of circumstances is not enough. *In re Oelrich*, 212 USPQ 323, 326 (CCPA 1981). Thus, even if one <u>possible</u> location of the window 52 and the amorphous silicon 53 shown in Figure 6 of Nakamura may be the claimed positioning of the introduction window, which Nakamura does not teach or suggest, such mere possibility would still not establish the asserted inherency, because other positions of the introduction window relative to the amorphous silicon that are different from the claimed positioning are also possible.

No see above

Applicants submit that the Patent Office has not shown that Nakamura inherently teaches the components of the object material hardly adhere to the introduction window nor any advantage to be gained by any certain positioning of the window 52 relative to the amorphous silicon 53. Thus, Nakamura does not teach or suggest that by using the claimed positioning, components of the amorphous material would hardly adhere to the window 52, as in the claimed invention.

In addition to the foregoing, claims 30 and 35 of the present application further recite that the high energy is supplied to the thin film under a pressure in a vicinity of the introduction window that is higher than a pressure in the vicinity of the thin film in the supply chamber. Neither Cathey nor Nakamura teaches or suggests the claimed method.

page 8 see above

As stated above, Cathey does not even teach a window. Nakamura does not teach a specific relationship between the pressures in the vicinity of the window 52 and in the vicinity of the silicon 53. Thus, Nakamura does not specifically teach that the pressure in the vicinity of the window 52 is higher than in the vicinity of the silicon 53.

Therefore, Cathey and Nakamura would not have rendered obvious claims 30 and 35. Claims 31-33 and 36-38 depend from claims 30 and 35, respectively, and accordingly are also allowable.

For the foregoing reasons, Applicants submit that Cathey and Nakamura, whether taken singly or in combination, fail to teach or suggest the present invention. Reconsideration and withdrawal of the rejection are respectfully requested.

B. <u>Claims 40-43, 46-49 and 56-61</u>

Claims 40-43, 46-49 and 56-61 were rejected by the Patent Office under 35 U.S.C. §103(a) as allegedly being anticipated by Cathey and Nakamura in view of Japanese Patent No. 63-3809 (hereinafter "JP-3809"). The rejection is respectfully traversed.

As set forth extensively above, Cathey and Nakamura fail to teach or suggest that energy is applied through a window that exhibits transparency to the energy, wherein the window is at a distance of more than about 20 mm from an object material as also recited in independent claims 40, 46 and 56 of the present application.

Cathey does not teach an introduction window. Cathey also does not provide a description regarding the path of the laser emission shown in Fig. 3D.

Further, the Nakamura device shown in Fig. 6 introduces gas into the chamber 51 through the inlet 60 in a direction that is perpendicular to the path of the laser beam. Nakamura does not teach or suggest a "gas flow from the introduction window to the thin film in approximately the same direction as the irradiation path" (emphasis added), as claimed. Thus, the applied references do not support the rejection of claim 40. page 10

The assertion of the Patent Office that alleges that Nakamura teaches that gas flow from the thin film is in approximately the same direction as the irradiation path since the hydrogen gas is vented through outlet 61 fails to teach or suggest the present invention. Claim 40 recites that gas flow from the introduction window to the thin film in approximately the same direction as the irradiation path. The gas flow in Nakamura is introduced perpendicular to that of the direction of the irradiation path.

The Patent Office states that claims 40-43, 46-49 and 56-61 are rejected over Cathey and Nakamura in view of "JP 62-3809." Applicants assume that the Patent Office means to recite "JP 62-3089" as submitted by Applicants in an Information Disclosure Statement. However, the Patent Office proceeds to describe figures in "JP 58-90722" rather than any material aspects of JP 62-3089.

Nonetheless, neither JP 62-3089 nor JP 58-90722 remedy the deficiencies of Cathey and Nakamura. In particular, neither JP 62-3089 nor JP 58-90722 teach or suggest that energy is applied through a window that exhibits transparency to the energy, wherein the window is at a distance of more than about 20 mm from an object material as also recited in independent claims 40, 46 and 56 of the present application. see above

Further, the gas introduced to the chamber of JP 62-3089 through port 211 and exhausted through port 212 does not appear to flow in approximately the same direction as the irradiation path as recited in claim 40 of the present application. JP 58-90722 also fails to teach or suggest gas introduced in approximately the same direction as the irradiation path. see above

Claim 46 also recites that the thin film is irradiated with the high energy introduced into the supply chamber through the introduction window, the high energy passes through the introduction window along an irradiation path and travels along the irradiation path in the supply chamber, and the high energy is supplied to the thin film with the normal direction of the thin film shifted by an angle from the direction of the irradiation path. The applied references fail to teach or suggest the method of claim 46. Regarding JP 58-90722, even if some reflection of a light beam by a thin film occurs, JP 58-90722 still does not teach or suggest that "the high energy passes through the introduction window along an irradiation path and travels along the irradiation path in the supply chamber," as claimed.

Furthermore, in Fig. 2, JP 58-90722 shows energy 10 being directed onto polycrystalline silicon 3, forming single crystal regions 3' with angled walls. The motivation asserted by the Patent Office for modifying Cathey to include this feature of JP 58-90722 references the Office Action of November 17, 1999, which only asserts combining JP 62-3089 with Nakamura. Nowhere does the Patent Office provide motivation for combining Cathey, Nakamura and JP 58-90722.

Cathey does not form any such openings in polycrystalline silicon as shown in JP 58-90722. The Office Action states no reason to form such openings in Cathey's thick substrates. Cathey uses a laser for recrystallizing or reforming amorphous or polysilicon material, and <u>not</u> for forming openings in these materials.

Thus, claim 46 would not have been rendered obvious. Claims 47-49 depend from claim 46 and, accordingly, are also allowable.

In addition, none of Cathey, Nakamura, JP 58-90722 and JP 62-3089 teach or suggest that "when a first position of the thin film is irradiated with the high energy introduced into the supply chamber, part of the high energy enters the thin film" and "another part of the high energy is reflected by the thin film to form reflected energy that irradiates a second position

of the thin film through a course change of the reflected energy" as recited in claim 56 of the present application.

None of these references teach or suggest a thin film that reflects energy such that a reflected part of the high energy irradiates a second portion of the thin film. Neither Cathey nor Nakamura shows any reflection by a thin film. JP 58-90722 appears to show reflection of energy 10, however, this disclosure does not suggest that the reflected energy is reflected to irradiate a second portion of the layer 3.

Thus, claim 56 is believed to be allowable. Claims 57-61 are also allowable for at least the same reasons as claim 56.

Claim 62 depends from claim 1 and thus also would not have been rendered obvious by the applied references.

For the foregoing reasons, Applicants submit that Cathey, Nakamura, JP 58-90722 and JP 62-3089 fail to teach or suggest the present invention. Reconsideration and withdrawal of the rejection are respectfully requested.

II. Conclusion

In view of the foregoing amendments and remarks, Applicants submit that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1, 2 and 4-63 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in better condition for allowance, the Examiner is invited to contact Applicants' undersigned representative at the telephone number listed below.

Respectfully submitted,

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JAO:DML/rxg

Attachment:
Appendix

Date: July 11, 2002

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DEPOSIT ACCOUNT USE AUTHORIZATION Please grant any extension necessary for entry; Charge any fee due to our Deposit Account No. 15-0461

Docket No. JAO 39514 Application No. 08/930,449

APPENDIX

Changes to Claims:

The following are marked-up versions of the amended claims:

1. (Five Times Amended) A method of forming a crystalline film, comprising:

forming a thin film having a surface on a glass substrate; and

crystallizing at least a surface layer of the thin film by applying energy through a window that exhibits transparency to the energy to the surface of the thin film, wherein a distance between the window and the thin film is more than about 20 mm, and at least the surface layer of the thin film is melted by the applied energy and crystallized by cooling solidification under a hydrogen-containing atmosphere,

wherein unpaired bonding electrons on the surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere.

12. (Five Times Amended) The method of forming a crystalline film, comprising:

forming a semiconductor thin film having a surface on a glass substrate; and

crystallizing at least a surface layer of the semiconductor thin film by applying energy through a window that exhibits transparency to the energy to the surface of the semiconductor thin film, wherein a distance between the window and the thin film is more than about 20 mm, and at least the surface layer of the semiconductor thin film is melted by the applied energy and crystallized by cooling solidification under an atmosphere containing a gas containing the component element of the semiconductor thin film and hydrogen,

wherein unpaired bonding electrons on the surface of the semiconductor thin film during the cooling solidification are terminated by hydrogen atoms in the atmosphere.

19. (Amended) A high energy supply apparatus for use with an object material, comprising:

a generation source that generates high energy; and

a supply chamber that supplies high energy to the object material, wherein:

the object material is disposed in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces high energy into the supply chamber; and

the introduction window is disposed at a location resistant to adherence of components of the object material to the introduction window when the high energy is supplied to the object material such that a distance between the introduction window and the object material is more than about 20 mm.

20. (Six Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate;

setting the thin film in a supply chamber of a high energy supply apparatus including a generation source for generating the high energy and the supply chamber for supplying the high energy to the thin film, the supply chamber including an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber;

crystallizing at least a surface layer of the thin film by supplying high energy through the introduction window to the thin film under a hydrogen-containing atmosphere, at least the surface layer of the thin film being melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification being terminated by hydrogen atoms in the hydrogen-containing atmosphere; and

positioning the introduction window relative to the thin film at a location resistant to adherence of components of the thin film when the high energy is supplied to the

thin film such that a distance between the introduction window and the thin film is more than about 20 mm.

24. (Amended) A high energy supply apparatus for use with an object material, comprising:

a generation source that generates high energy; and

a supply chamber that supplies high energy to the object material, wherein;

the object material is disposed in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces high energy into the supply chamber; and

a distance between the introduction window and the object material is larger than ~~a shortest distance between the wall and the object material~~ about 20 mm.

25. (Six Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate;

setting the thin film in a supply chamber of a high energy supply apparatus including a generation source for generating the high energy and the supply chamber for supplying the high energy to the thin film, the supply chamber including a wall and an introduction window provided in a portion of the wall, the introduction window introducing the high energy into the chamber;

crystallizing at least a surface layer of the thin film by supplying high energy through the introduction window that exhibits transparency to the energy to the thin film under a hydrogen-containing atmosphere, at least the surface layer of the thin film being melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification being terminated by hydrogen atoms in the hydrogen-containing atmosphere; and

positioning the introduction window relative to the thin film so that a distance between the introduction window and the thin film ~~being~~ is larger than ~~a shortest distance between the wall and the thin film when the high energy is supplied to the thin film~~ about 20 mm.

29. (Amended) A high energy supply apparatus for use with an object material, comprising:

a generation source that generates high energy; and

a supply chamber that supplies high energy to the object material, wherein;

the object material is disposed in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the object material is more than about 20 mm; and

the supply chamber has pressure regulating means for permitting the pressure in the vicinity of the introduction window to be higher than the pressure in the vicinity of the object material.

30. (Five Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a substrate; and

crystallizing at least a surface layer of the thin film by supplying high energy to the thin film under a hydrogen containing atmosphere, at least the surface layer of the thin film is melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere, wherein:

crystallizing is carried out in a high energy supply apparatus which includes a generation source for generating the high energy and a supply chamber for a supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm; and

the high energy is supplied to the thin film under a pressure in the vicinity of the introduction window that is higher than a pressure in the vicinity of the thin film in the supply chamber.

34. (Amended) A high energy supply apparatus for use with an object material comprising:

a generation source that generates high energy; and

a supply chamber that supplies high energy to the object material, wherein;

the object material is disposed in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the object material is more than about 20 mm, and an exhaust port for exhausting the supply chamber; and

the supply chamber has pressure regulating means for permitting the pressure in a vicinity of the introduction window to be higher than a pressure in the vicinity of the object material, and the pressure in the vicinity of the object material to be higher than a pressure in the vicinity of the exhaust port.

35. (Five Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate; and

crystallizing at least a surface layer of the thin film by supplying high energy to the thin film under a hydrogen-containing atmosphere, at least the surface layer of the thin film is melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere, wherein:

crystallizing is carried out in a high energy supply apparatus which includes a generation source for generating the high energy and supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber includes an introduction window that that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm, and an exhaust port for exhausting air in the supply chamber; and

the high energy is supplied to the thin film under (i) a pressure in the vicinity of the introduction window that is higher than a pressure in the vicinity of the thin film, and (ii) a pressure in the vicinity of the thin film that is higher than a pressure in a vicinity of the exhaust port in the supply chamber.

39. (Amended) A high energy supply apparatus for use with an object material, comprising:

a generation source that generates high energy; and

a supply chamber that supplies high energy to the object material, wherein;

the object material is disposed in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the object material is more than about 20 mm;

the object material is irradiated with the high energy introduced into the supply chamber through the introduction window along an irradiation path assumed in the supply chamber;

a part of the high energy enters the object material, and another part is reflected from the object material and travels along a reflection path assumed in the supply chamber;

a gas flow is present in the supply chamber; and

the supply chamber has gas flow regulating means for permitting the gas flow to travel from the introduction window to the object material in substantially the same direction as the irradiation path, and a gas flow from the object material in substantially the same direction as the reflection path.

40. (Five Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate;

crystallizing at least a surface layer of the thin film by supplying high energy to the thin film under a hydrogen-containing atmosphere, at least the surface layer of the thin film is melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere, wherein:

crystallizing is carried out in a high energy supply apparatus which includes a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm;

the thin film is irradiated with the high energy introduced into the supply chamber through the introduction window along ~~a~~ an irradiation path in the supply chamber;

a part of the high energy enters the thin film, and another part of the high energy is reflected from the thin film along a reflection path in the supply chamber;

a gas flow is present in the supply chamber; and

the high energy is supplied to the thin film with (i) the gas flow from the introduction window to the thin film in approximately the same direction as the irradiation path, and (ii) the gas flow from the thin film in approximately the same direction as the reflection path.

44. (Amended) A high energy supply apparatus for use with an object material, comprising:

a generation source that generates high energy; and

a supply chamber that supplies high energy to the object material, wherein:

the object material is disposed in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber;

the thin film is irradiated with the high energy which is introduced into the supply chamber through the introduction window along an irradiation path assumed in the supply chamber; and

the introduction window is disposed so that the normal line of the thin film is shifted from the direction of the irradiation path and a distance between the introduction window and the object material is more than about 20 mm.

45. (Amended) A high energy supply apparatus for use with an object material, comprising:

a generation source that generates high energy; and

a supply chamber that supplies high energy to the object material, wherein:

the supply chamber has setting means for setting the thin film therein;

the supply chamber has an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the object material is more than about 20 mm;

the thin film is irradiated with the high energy which is introduced into the supply chamber through the introduction window along an irradiation path assumed in the supply chamber; and

the setting means is disposed so that the normal line of the thin film is shifted from the direction of the irradiation path.

46. (Six Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate; and

crystallizing at least a surface layer of the thin film by supplying high energy through an introduction window that exhibits transparency to the energy to the thin film under a hydrogen-containing atmosphere, at least the surface layer of the thin film is melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere, wherein:

crystallization is carried out in a high energy supply apparatus that includes a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has ~~an~~ the introduction window provided in a portion of the wall of the supply chamber, for introducing the high energy into the supply

chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm;

the thin film is irradiated with the high energy introduced into the supply chamber through the introduction window, the high energy passes through the introduction window along an irradiation path and travels along the irradiation path in the supply chamber; and

the high energy is supplied to the thin film with the normal direction of the thin film shifted by an angle from the direction of the irradiation path.

50. (Amended) A high energy supply apparatus for use with an object material, comprising:

a generation source that generates high energy; and

a supply chamber that supplies high energy to the object material, wherein;

the thin film is disposed in the supply chamber;

when the high energy is introduced into the supply chamber through a window that exhibits transparency to the energy to irradiate the object, part of the high energy enters the object material, and another part is reflected from the object material to form reflected energy, wherein a distance between the window and the object material is more than about 20 mm; and

the supply chamber and course changing means for irradiating again the object material with the reflected energy.

56. (Five Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate; and

crystallizing at least a surface layer of the thin film by supplying high energy through an introduction window that exhibits transparency to the energy to the thin film under a hydrogen-containing atmosphere, at least the surface layer of the thin film is melted

by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere, wherein:

crystallization is carried out in a high energy supply apparatus including a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has ~~an~~ the introduction window provided in a portion of the wall of the supply chamber, for introducing the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm;

when a first position of the thin film is irradiated with the high energy introduced into the supply chamber, part of the high energy enters the thin film; and another part of the high energy is reflected by the thin film to form reflected energy that irradiates a second position of the thin film through a course change of the reflected energy.